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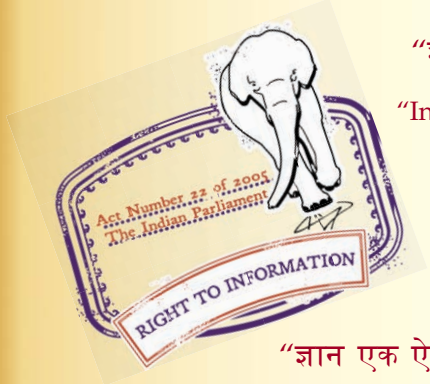
IS 309 (2005): Compressed Oxygen gas [CHD 6: Industrial Gases]



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भारतीय मानक

सम्पीड़ित ऑक्सीजन गैस — विशिष्टि

(चौथा पुनरीक्षण)

Indian Standard

COMPRESSED OXYGEN GAS — SPECIFICATION

(Fourth Revision)

ICS 71.100.20

BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

September 2005

Price Group 4

FOREWORD

This Indian Standard (Fourth Revision) was adopted by the Bureau of Indian Standards, after the draft finalized by the Industrial Gases Sectional Committee had been approved by the Chemical Division Council.

This standard was originally published in 1956 and then subsequently revised in 1965, 1974 and 1992 respectively. In third revision, a new method of test for determination of moisture has been incorporated. The requirements for packing and sampling have also been modified. The packing of compressed oxygen gas in cylinders and the marking of the cylinders has been made to conform with the provision of the *Gas Cylinder Rules*, 1981 of the Government of India, with such modifications as may be issued from time to time by the Chief Controller of Explosives.

In this standard method of test for determination of carbonmonoxide, carbondioxide and total hydrocarbons have been incorporated with a view to harmonize it with corresponding British Standard BS 4364 : 1993 'Specification for industrial oxygen'.

At present, there is no ISO Standard on the subject.

The composition of the Committee responsible for the formulation of this standard is given at Annex F.

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS 2 : 1960 'Rules for rounding off numerical values (*revised*)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

Indian Standard

COMPRESSED OXYGEN GAS — SPECIFICATION

(Fourth Revision)

1 SCOPE

1.1 This standard prescribes requirements and methods of sampling and test for compressed oxygen gas for industrial use.

1.2 This standard does not cover aviation oxygen and that for medical or inhalation purposes.

2 REFERENCES

The standards listed below contain provisions, which through reference in this text constitute provisions of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below:

IS No.	*Title*
1070 : 1992	Reagent grade water (*third revision*)
1260 (Part 1) : 1973	Pictorial marking for handling and labelling of goods: Part 1 Dangerous goods (*first revision*)
4379 : 1981	Identification of contents of industrial gas cylinders (*first revision*)
7062 : 1973	Glossary of terms used in gas industry

3 TERMINOLOGY

For the purpose of this standard, the definitions given in IS 7062 shall apply.

4 REQUIREMENTS

4.1 Purity

The purity of compressed oxygen gas shall be minimum 99.0 percent by volume when tested by the method prescribed in Annex A.

4.2 Dew Point

The dew point or oxygen gas shall be at least –40°C measured at atmospheric pressure when tested by the method prescribed in **B-2**, **B-3** and **B-4** or moisture content in oxygen shall be not more than 0.102 g/Nm^3 corresponding to dew point of –40°C when tested by the method prescribed in **B-5**.

4.3 Volume Fraction of Carbonmonoxide and Carbondioxide

Volume fraction of carbonmonoxide shall not be more than 2×10^{-6} and carbondioxide shall not be more than 3×10^{-6} when determined by the method prescribed in Annex C.

4.4 Volume Fraction of Hydrocarbons

Volume fraction of hydrocarbons expressed as methane shall not be more than 50×10^{-6} when determined by the method presented in Annex D.

NOTE — Oxygen gas produced by air separation process shall not normally contain any carbonmonoxide, carbondioxide and hydrocarbon. So for presence of these impurities in industrial oxygen produced by air separation process, tests shall be carried out only on agreement of such tests between the buyer and the seller. For oxygen gas produced by other methods, determination of these impurities, that is, carbonmonoxide, carbondioxide and total hydrocarbon shall be carried out along with other tests mentioned in **4.1** and **4.2**.

5 PACKING AND MARKING

5.1 Packing

The gas shall be supplied compressed in cylinders of approved designs and of suitable capacity, and conforming to the requirements prescribed in the *Gas Cylinder Rules,* 1981 of the Government of India, with such modifications as may be ordered from time to time by the Chief Controller of Explosives, Government of India, or any other duly constituted authority.

5.1.1 The quantity of oxygen gas packed in a gas cylinder shall be measured at 15°C and 760 mm of Hg and shall be expressed in cubic metre.

5.2 Marking

The marking, painting, labelling and transport of cylinders shall be in accordance with the requirements of the *Gas Cylinder Rules*, 1981 of the Government of India, with such modification as may be ordered from time to time by the Chief Controller of Explosives, Government of

India, or any other duly consitituted authority. The cylinders shall also be marked as shown in IS 1260 (Part 1) and IS 4379.

5.3 BIS Certification Marking

The cylinders may also be marked with the Standard Mark.

5.3.1 The use of the Standard Mark is governed by the provisions of the *Bureau of Indian Standards Act*, 1986 and Rules and Regulations made thereunder. The details of conditions under which the licence for use of the Standard Mark may be granted to manufacturers or producers may be obtained from the Bureau of Indian Standards.

6 SAMPLING

The method of drawing representative samples of the material and criteria for determining conformity of the material to the requirements of this standard shall be as prescribed in Annex E.

ANNEX A
(*Clause* 4.1)

DETERMINATION OF PURITY OF OXYGEN GAS

A-1 QUALITY OF REAGENTS

Unless specified otherwise, pure chemicals and distilled water (*see* IS 1070) shall be employed in tests.

NOTE — 'Pure chemicals' shall mean chemicals that do not contain impurities, which affect the results of analysis.

A-2 APPARATUS

The apparatus shall be as shown in Fig. 1.

A-3 REAGENTS

A-3.1 Copper Wire

A-3.1.1 *Ammonia Solution* — Dissolve 550 g of ammonium chloride (NH_4Cl) in 1085 ml of water and to this solution add 917 ml of ammonium hydroxide solution (relative density 0.90).

A-4 PROCEDURE

A-4.1 Invert the copper wire container *C*, remove the bung and fill it with copper wire in spiral or other form. Then fill it with ammonia solution and replace the bung. Return *C* to upright position. Pour the ammonia solution into the levelling tube *A* until it is about three quarters full. Then operate the three-way stopcocks *E* and *H* so that burette *B* is in communication with the atmosphere through inlet *E*, and by raising levelling tube *A*, completely fill burette *B*. Keeping *A* raised, turn *E*, so that *B* is in communication with *C*, and allow the solution to pass into *C*, until *D* is half full. Close *E*, lower *A* and operate *E* to draw from *C* into *B*. Close *E* when capillary of *E* is full of liquid. Raise *A* and operate *E* to expel gas from *B* to the atmosphere through *F*, closing *E* when the capillary *H* is full of liquid. Fill the lute *G* with a head of about 50 mm of water and connect *F* with sample gas and purge the gas from the lute *G*. Draw in the sample through *F* (taking care that no air is sucked in through *F* during this operation), until the liquid level in *B* is at the zero mark and is at the same level with that in *A*. Pass the gas into *C* by suitably operating the cock *B*, and raising *A*. Shake thoroughly and then draw back the unabsorbed gas into *B* by lowering *A* and operating the cock *E*, until a little solution from the capillary trickles down into *B* in order to ensure that the capillary in the plug of cock *E* is filled with liquid before leveling up and reading the volume of the gas. Repeat the process a number of times until no further absorption takes place.

A-4.2 Renewal of the Solution

When the solution is spent, close *E*, remove the bung from *C* and drain out the solution from *C* and *D*. Invert *C* and fill it with fresh solution. Replace the bung and set *C* and *D* in proper places and in upright position. Now add fresh solution to the partially spent solution of *A* and repeat the process as indicated under **A-4.1**.

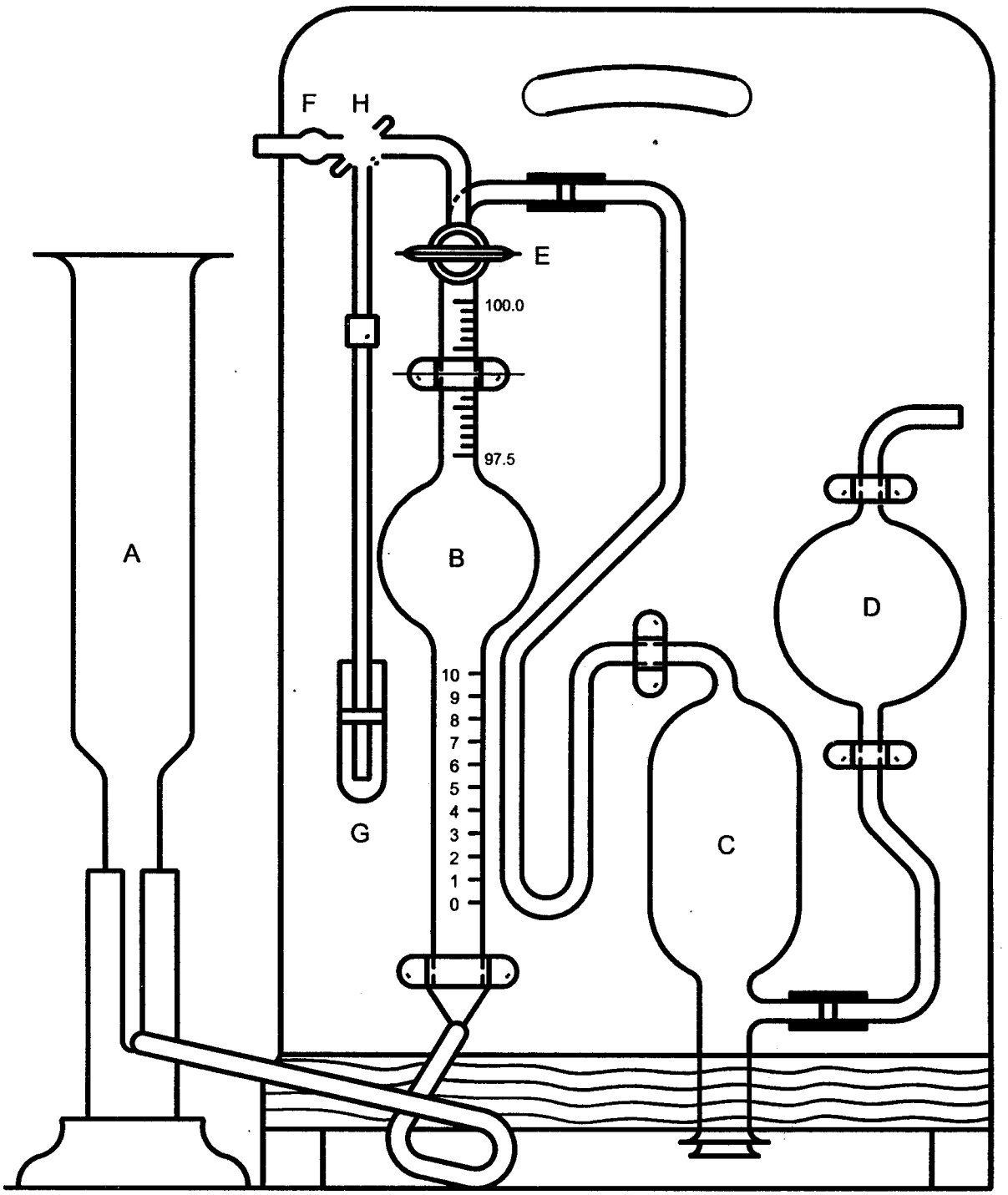
A-5 CALCULATION

$$\text{Oxygen, percent by volume} = \frac{V - V_1}{V} \times 100$$

where

V = volume of the gas sample taken for the test, in ml; and

V_1 = volume of the gas after absorption, in ml.



A = LEVELLING TUBE
B = GRADUATED BURETTE FOR OXYGEN TESTING
C = COPPER WIRE CONTAINER
D = RESERVOIR FOR SOLUTION
E&*H* = THREE-WAY STOP COCKS
F = INLET FOR GAS SAMPLE
G = LUTE

FIG. 1 ASSEMBLY OF APPARATUS FOR DETERMINATION OF OXYGEN

ANNEX B
(*Clause* 4.2)

DETERMINATION OF WATER VAPOUR

B-1 GENERAL

Presence of moisture in oxygen gas shall be determination by dew point or by weight of moisture content. For dew point determination, electrolytic hygrometer, frost or dew point hygrometer, and capacitance hygrometer shall be used. For determination of weight of moisture content, absorption method shall be followed. The procedure to be followed for determining the dew point by hygrometer method shall depend upon type of apparatus to be used and manufacturer's instruction.

B-2 ELECTROLYTIC HYGROMETER

The method is based on the absorption and electrolysis of the water vapour present in the sample gas. The electrolytic current given a direct measurement of water vapour present in the gas flowing through the instrument at a steady rate. The exact procedure to be followed shall depend on the type on apparatus to be used. The instrument manufacturer's instructions in this regard shall be followed.

B-3 FROST OR DEW POINT HYGROMETER

A metal surface on the hygrometer is cooled so that dew or frost is formed from the water vapour content of the gas at a particular pressure which may be observed optically in the apparatus. The temperature at which the dew or frost is formed is a measure of water vapour content of the gas. The exact procedure to be followed shall depend upon the type of apparatus to be used. The instrument manufacturer's instructions in this regard shall be followed.

B-4 CAPACITANCE HYGROMETER

The method is based on the change of capacitance of the sensor when a sample gas containing water vapour passes through it. The change in capacitance gives a direct measurement of water vapour present in the gas. The procedure to be followed shall depend upon the type of apparatus to be used. The instrument manufacturer's instructions in this regard shall be followed.

B-5 ABSORPTION METHOD

B-5.1 Apparatus

The apparatus consists of the following parts assembled as shown in Fig. 2.

B-5.1.1 *Gas Meter*, accurate to 1 percent.

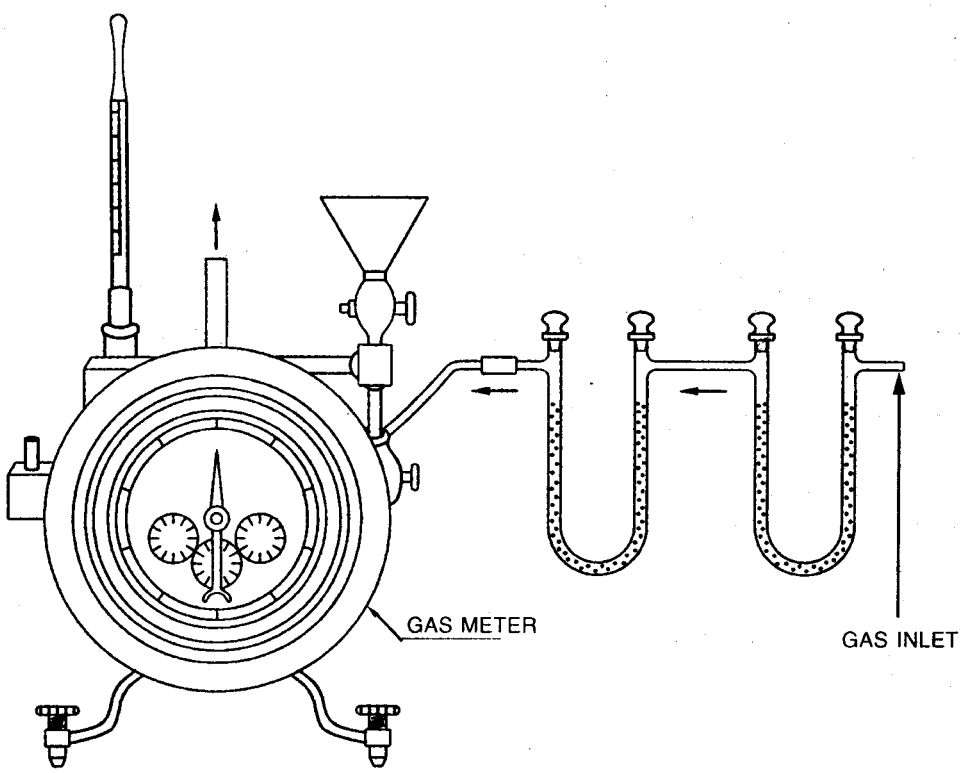


FIG. 2 ASSEMBLY OF APPARATUS FOR THE DETERMINATION OF MOISTURE

B-5.1.2 *Absorption Train*, three U tubes containing phosphorus pentoxide connected in series to the gas meter. The one near to the gas meter will serve as a guard to prevent moisture from backing into the first two tubes.

B-5.2 Procedure

B-5.2.1 Absorption of moisture from a known volume of oxygen gas by anhydrous calcium chloride ($CaCl_2$) or phosphorous pentoxide (P_2O_5) or Silica Gel or mol. Seive held in a series of U tubes.

B-5.2.2 Quantity of gas flow through U tube train shall be measured by a rotometer or any other type of flow meter having accuracy not less than ±5 percent. Flow rate shall be about 500 l/h and not more to ensure complete absorption of oxygen in the hygroscopic chemicals held in U tube train.

B-5.2.3 U tube train filled with hygroscopic chemicals shall be initially heated to 100°C or more depending on the chemical for 1 h to drive away any moisture absorbed previously by the chemicals. The two ends of the U tube train shall be firmly closed with rubber stopper not to allow ingress of atmospheric air. Weight of the whole U tube train shall be taken on a sensitive chemical balance of accuracy not less than ±1 percent. The U tube train shall be heated again in two intervals for 15 min each and weighed again after each 15-minutes heating to see that there is no further fall in weight of the U tube train, ensuring that moisture from the chemicals have been removed.

B-5.2.4 At least one cylinder full of oxygen gas at full filling pressure having 6 to 7 m^3 of oxygen gas shall be connected to the U tube train through pressure regulator and flow meter. The entire quantity of oxygen gas from the cylinder shall be passed through U tube train at a rate of about 500 l/h and when the cylinder is empty in about 10 h. Both ends of the U tube train shall be firmly closed with rubber stopper not to allow any moisture from atmospheric air to get in.

B-5.2.5 U tube train after absorption of moisture from oxygen gas shall be weighed in chemical balance and weight of moisture absorbed from oxygen gas shall be found by the difference in weight of the U tube train before commencement of flow of oxygen and after completion of the flow of oxygen.

B-5.3 Calculation

B-5.3.1 Volume of total oxygen gas flow shall be checked from the flow meter. Alternatively total quantity of oxygen gas flow can be found out from water capacity of gas cylinder punched on the body of the cylinder and the difference between the initial full pressure of oxygen gas in the cylinder and the final pressure of oxygen in the gas cylinder when flow is stopped. The quantity of gas flow can be found out in the following manner.

The water capacity of gas cylinder punched on the body : X litre

Pressure of the gas cylinder full with oxygen : P_1 bar

Pressure in oxygen gas cylinder when gas flow from cylinder is stopped : P_2 bar

Total quantity of oxygen gas flow from cylinder to the 'U' tube train:

$$= \frac{X \times (P_1 - P_2)}{1\,000} \text{ m}^3$$

'm^3' shall be converted to '$N\ m^3$' by applying gas law :

$$\frac{PV}{T} = K$$

If chemical balance employed for weighment is not enough sensitive, in that case gas from more than one oxygen cylinder may be passed to increase absorption of more moisture and thereby to increase the weight of the U tube train for easier weighment.

B-5.3.2 The weight of moisture absorbed in the U tube train in grams divided by the volume of the oxygen passed, in Nm^3, shall show moisture content, in g/Nm^3.

B-5.3.3 The above test shall be repeated 3 times and the average moisture content in g/Nm^3 shall be determined. This shall not be more than 0.102 g/Nm^3 corresponding to –40°C dew point.

ANNEX C
(*Clause* 4.3)

DETERMINATION OF VOLUME FRACTION OF CARBONMONOXIDE AND CARBONDIOXIDE

C-1 The method for determination of volume fraction of carbonmonoxide and carbondioxide present in oxygen shall use the principle of infrared absorption in specific wave length by different molecules. ' Scanning infrared spectrometer' shall be used after calibration. Instruction of the manufacturers of the instrument shall be followed for calibration and calculation of volume fraction of carbonmonoxide and carbondioxide in oxygen sample.

ANNEX D
(*Clause* 4.4)

DETERMINATION OF VOLUME FRACTION OF HYDROCARBONS

D-1 Gas chromatograph with flame ionization detector, gas sampling value, suitable valve to 'backflash' hydrocarbon to detector shall be used for the determination of volume fraction of hydrocarbon. Nitrogen gas shall be used as carrier gas. Instruction of the manufacturer of the instrument shall be followed for calibration and calculation of volume fraction of hydrocarbons in oxygen gas.

ANNEX E
(*Clause* 6)

SAMPLING OF COMPRESSED OXYGEN GAS

E-1 PROCEDURE

E-1.1 On regular production, two samples selected at random shall be tested per hour of compression.

E-1.1.1 The production shall be declared as conforming to this standards, if the sample passes the oxygen and moisture content test.

E-1.1.2 However, if the sample fails in the oxygen and moisture content test, then the sampling frequency shall be doubled till all the samples pass for consecutive 2 h.

ANNEX F
(Foreword)

COMMITTEE COMPOSITION

Industrial Gases Sectional Committee, CHD 6

Organization	*Representative(s)*
Praxair India Pvt Ltd, Bangalore	SHRI R. S. DHULKHED (***Chairman***)
All India Industrial Gases Manufacturers' Association, New Delhi	DR P. L. BHATIA SHRI B. N. QANUNGO (*Alternate*)
Association of Automobiles Manufacturers of India, New Delhi	REPRESENTATIVE
Bharat Heavy Electricals Ltd, Hyderabad	SHRI N. V. S. RAMANI SHRI A. RAJAMOHAN (*Alternate*)
BOC India Ltd, Kolkata	SHRI P. AMARNATH
Central Electronics Ltd, Ghazibabad	SHRI M. I. ALAM
Chief Controller of Explosives, Nagpur	SHRI R. H. BHALEKAR SHRI S. K. BHARDWAJ (*Alternate*)
Department of Electronics, New Delhi	DR U. C. PANDEY
Department of Industrial Development, New Delhi	SHRI P. K. JAIN SHRI N. C. TIWARI (*Alternate*)
Everest Kanto, Mumbai	REPRESENTATIVE
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Sylvania & Laxman Ltd, New Delhi	SHRI S. K. KAPOOR SHRI NAVEEN SIKKA (*Alternate*)
The Asiatic Oxygen and Acetylene Co Ltd, Kolkata	SHRI B. N. SINHA
The Industrial Gases Ltd, Kolkata	SHRI T. GARG SHRI L. R. GARG (*Alternate*)
BIS Directorate General	DR U. C. SRIVASTAVA, Director & Head (Chem) [Representing Director General (*Ex-officio Member*)]

Member Secretary
SHRI P. GHOSH
Director (Chem), BIS

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Amend No.	Date of Issue	Text Affected

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